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UNITED STATES
DEPARTMENT OF THE INTERIOR
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BUREAU OF MINES
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INFORMATION CIRCULAR

NONMETALLIC MINERALS NEEDED FOR NATIONAL DEFENSE:

4. BUILDING MATERIALS

BY

LEO J. O'NEILL

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4. BUILDING MATERIALS 1/

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INTRODUCTION AND CONCLUSIONS

In view of the fact that large quantities of building materials were being imported into the United States at the outbreak of war in September 1939, and inasmuch as future building activity may cause unprecedented demand for some of these materials, the Bureau of Mines has received numerous inquiries regarding the adequacy of domestic raw-mineral resources and fabricating-plant capacities to provide the necessary quantities of materials if imports are cut off entirely.

Without attempting to evaluate the possible demand for various types of materials, it may be said that it is not at all improbable that the total volume of construction, both residential and nonresidential, will exceed the peak reached during the boom of the late 1920's. In 1928, the Federal Reserve Board index of building construction reached an all-time high of 135; in December 1940, the index had advanced to 115, the highest point since 1928. There are several reasons for predicting a new peak, possibly within the present year; the most important are (1) The number of new factories built to produce materials and equipment for the national-defense and aid-to-Britain programs; (2) building of housing for the armed forces; (3) construction at

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the recently acquired air bases in the Atlantic, at defense posts in the Pacific, and in airport-expansion programs; and (4) demand for housing units, repressed during the 1930's but developing now as a result of the rise in national income.

The building-materials picture is far different today from that in 1928. Then foreign products were kept from the American market only by tariff barriers and natural causes. Lower wages in foreign countries plus cheap water rates - often less than domestic rail rates from producing centers - to densely populated areas along the Atlantic, Pacific, and Gulf coasts permitted imports to compete with American goods produced by better-paid labor.

The natural effect of persistent imports, unless compensated by an equal volume of exports, is to lower the plant capacity necessary to meet normal demands. It is obvious that curtailment of imports, particularly in the face of increased demand, may create shortages. In building materials, however, the Nation is potentially self-sufficient except for one raw material - asbestos - and any shortage that may occur in other materials should be temporary and capable of being eliminated after a period of adjustment.

Foreign products - notably cement from Belgium, glass from Belgium, Czechoslovakia, and Germany, and gypsum from Canada - were cheaper in the New York market and at other points along the Atlantic seaboard not only because wages in most foreign countries are lower but also because ocean freight rates are often less than rail rates from some of the producing centers in this country. Replacement of imports with domestic materials may be expected to result in higher prices in some localities because of higher transportation costs.

Because of consumer preference, marbles were imported from Italy and Belgium and granite from Finland and Sweden, even though the American products were cheaper and, from a strictly utilitarian standpoint, equally desirable. Imports of these stones could be cut off without seriously dislocating the domestic building industry. In fact, natural causes already had reduced employment of foreign stone after 1931.

Domestic production of asbestos is small, but adequate supplies for the important building uses are imported, chiefly from Canada. Asbestos may be grouped into three classes: Long-fiber for spinning into cloth and fabric for brake linings, clutch facings, insulating mats, and similar uses; short-fiber for insulating and other building purposes; and fines for use in asbestos cement. Only the long-fiber is considered by the Army and Navy Munitions Board to have critical importance because short-fiber and fines are employed in less essential products and because they are obtainable from Canada without difficulty. A considerable tonnage of the long-fiber type is scheduled for stock-piling by the Federal Government.

Domestic deposits of raw materials and fabricating facilities for the other nonmetallic building materials are adequate for present requirements, and production can be expanded very greatly if necessary. This is certainly true as regards items that in the past have been imported in small amounts

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and also as regards gypsum, cement, stone, and glass. Bottlenecks may develop at certain steps in the manufacture of fabricated products, but it is believed that these will be minor and temporary in character.

GENERAL TRENDS

Table 1 gives imports of mineral building materials and several manufactured building materials for 1929 and 1938. Table 2 gives domestic production of the same or similar materials for the same years.

The trend of imports of building materials over the period 1929-37 was downward, as was to be expected from the general lapse in building activity over these years. However, in the case of several imported materials the decline from 1929 to 1937 was far more pronounced than the 50-percent decline in building construction.

Decreases of more than 50 percent in the volume of imports for consumption in 1937 compared with 1929 were shown for the following: Rough monumental and building stone, exclusive of marble and granite (99 percent); asbestos shingles, packing, wall board, and cement (97 percent); rough blocks of marble, onyx, and breccia (89 percent); rough granite blocks (80 percent); sand and gravel (71 percent); slabs or paving tiles of marble, onyx, and breccia (67 percent); and lime (59 percent). The quantities of imports for consumption of crude gypsum and white, nonstaining portland cement declined 13 percent and 49 percent, respectively, in 1937 compared with 1929.

Increases in volume of imports over the period were shown for hydraulic cement (4 percent), mill-fiber, and refuse asbestos (22 and 41 percent, respectively).

Declines in value of imports for consumption in 1937 compared with 1929 were shown for the following commodities, statistics as to the quantities of which are not readily available: Roofing (39 percent); mosaic cubes of marble or onyx (90 percent); cylinder, crown, and sheet glass (46 percent); and granite, polished or dressed (39 percent).

DIMENSION STONE

Marble

Marble is essentially calcium carbonate or calcium magnesium carbonate crystallized by the action of heat and pressure on beds of limestone or dolomite. It usually contains impurities that impart the various colors often found in this stone. Marble is used principally for building and monumental purposes. In buildings it is generally employed in slab form as a veneer for both exterior and interior surfaces, backed by concrete or other material. Small quantities are consumed in the manufacture of statuary and novelties.

TABLE 1. - Imports of building materials for consumption 1/

	Unit	1929		1937	
		Quantity	Value	Quantity	Value
Marble, breccia and onyx:					
In blocks, rough, etc.	cubic feet	667,900	$1,591,070	75,302	$297,501
Sawed	do	10,859	24,799	165	488
Slabs or paving tiles	superficial feet	649,899	253,267	214,588	67,789
Mosaic cubes of marble or onyx:					
Loose	pounds	-	2/ 1,875	9,362	180
Granite:					
Dressed	cubic feet	-	292,644	36,853	178,607
Rough	do	216,022	378,943	43,871	67,212
Travertine stone:					
Rough	do	(3)	(3)	13,404	18,677
Stone (other):					
Dressed	-	-	62,674	-	6,310
Rough (monumental & building)	cubic feet	240,399	184,620	2,547	6,617
Slate (roofing)	squares	-	4/15,379	1,025	9,382
Other building materials:					
Sand and gravel	short tons	1,666,387	751,602	482,540	170,623
Cement:					
Roman, portland, and other Hydraulic	barrels	1,720,273	5/ 1,929,929	1,791,124	5/1,352,758
White, nonstaining portland	do	25,072	5/54,045	12,808	5/ 39,875
Lime:					
Hydrated	short tons	6,347	97,238	1,174	13,885
Other	do	15,154	293,498	6/7,614	76,720
Gypsum:					
Crude	do	1,036,385	1,060,874	897,484	854,835
Ground or calcined	do	4,979	69,703	2,064	30,082
Manufactured plaster of Paris	-	-	71,479	-	78,456
Keene's cement	short tons	430	11,327	25	675

(See footnotes on page 5)

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TABLE 1. - Imports of building materials for consumption 1/ - Cont'd.

	Unit	1929		1937	
		Quantity	Value	Quantity	Value
Clay products:					
Clay and cement tiles	square feet	4,602,477	991,644	2,062,651	107,811
Ceramic mosaics.............	do	968,968	298,813	64,394	7,918
Quarry tiles................	do	323,086	54,876	42,634	6,410
Mantles, friezes, and other articles of earthen tiles...	do	36,635	10,426	-	2,024
Asbestos:					
Unmanufactured:					
Crude (includes blue fiber)	short tons	15,157	4,334,060	14,326	1,926,057
Mill fiber..................	do	85,154	4,575,579	103,766	5,139,317
Stucco and refuse (short fiber)	do	7/133,988	7/2,243,378	189,096	3,404,834
Manufactures:					
Shingles	pounds	56,141,951	750,751	1,614,340	19,237
Packing, not fabric	do	229,534	110,233	45,619	18,235
Papers, millboards and wallboards	do	428,099	22,213	605	129
Cement	do	50,199	2,209	-	-
Glass (cylinder, crown, and sheet)	-	-	2,768,250	-	1,504,259

1/ Compiled from Foreign Commerce and Navigation, U.S. Department of Commerce.
2/ Attached to paper, $33.
3/ Not separately classified.
4/ General imports, value approximate.
5/ Includes cost of containers.
6/ Includes weight of immediate containers.
7/ No stucco imported.

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TABLE 2. - United Stated production of building materials 1/

	Unit	1929		1937	
		Quantity	Value	Quantity	Value
Dimension stone for building:					
Marble	cubic feet	2,778,800	$12,125,716	731,700	$3,336,545
Granite	do	6,202,270	8,105,364	3,322,830	3,068,155
Limestone	do	17,864,700	20,649,257	7,736,140	5,096,535
Sandstone	do	4,870,670	2,666,314	1,965,480	944,952
Miscellaneous	do	2,556,900	293,010	739,750	675,005
Basalt	do	487,800	65,462	189,120	21,482
Slate (roofing)	squares	462,120	4,920,766	365,800	2,728,109
Other building materials:					
Sand	short tons	41,161,013	23,309,238	27,590,739	15,405,031
Gravel	do	32,448,800	23,813,885	27,838,317	19,526,213
Crushed stone	do	2/76,174,770	2/80,685,493	2/54,154,680	2/ 49,209,747
Cement: 3/					
Portland	barrels	169,868,322	252,153,789	113,804,782	168,835,208
Masonry, natural and puzzolan	do	2,159,130	2,950,717	1,873,400	2,578,885
Lime	short tons	1,640,827	14,303,539	948,553	8,212,995
Gypsum, calcined 4/	do	5/ 4,017,909	5/ 36,857,589	2,517,222	35,516,684
Manufactures: 6/					
Asbestos:					
Shingles	squares	894,164	5,277,308	2,100,364	11,519,411
Lumber, plain and corrugated	square feet	35,395,194	3,094,426	34,887,159	2,815,814
Other asbestos building material 7/	-	-	2,051,884	-	3,893,319
Tile:					
Roofing	squares	370,771	3,943,847	228,335	2,053,863
Ceramic mosaic and floor tile	square feet	33,939,024	7,511,674	24,980,222	4,120,205
Wall and enameled	do	46,420,548	18,700,491	37,601,809	11,159,706
Faience	do	3,379,486	2,689,823	1,632,523	595,108
Draintile and sewer pipe	short tons	2,533,974	27,845,885	1,416,644	17,307,521
Structural brick and tile	-	-	122,969,408	-	63,949,830
Terra cotta	short tons	133,958	13,921,244	28,747	2,914,801
Glass:					
Plate	square feet	148,742,970	50,191,535	-	9/100,938,681
Window 8/	do	479,669,850	37,209,887	-	

1/ Source: Mineral Resources (1929) and Minerals Yearbook (1938), Bureau of Mines. 2/ Includes stone used for road metal; separate figures not available. 3/ Shipments. 4/ Gypsum products made from domestic, imported, and byproduct crude gypsum sold or used in the United States. 5/ Exclusive of bast-coat plasters, for which data are not available. 6/ Compiled from Census of Manufactures, U. S. Department of Commerce. 7/ Asbestos flexible roofing, asbestos wall tile, and miscellaneous asbestos building materials. 8/ Includes obscured glass, cathedral and skylight glass, opalescent sheet glass, and rough 9/ Total flat glass (includes window, obscured, wire, and other flat glass, in-

Deposits of marble are distributed widely throughout the world and have been exploited extensively in the United States in a belt that runs from Vermont through Massachusetts, New York, Pennsylvania, Virginia, and Tennessee to the northern part of Alabama. Smaller operations are to be found in the Rocky Mountain and Pacific Coast States. Although large quantities of marble have been imported from Europe, the domestic product has been shipped to all parts of the world and the value of exports roughly equals the declared or foreign-market value of imports.

Onyx marble deposits are found in Arizona, California, and Montana but have not been developed extensively inasmuch as their products have not yet attained the popularity of Mexican and Argentine types, which constitute the bulk of imports.

Most of the marble imports have come from Italy, but Belgium and France also have supplied substantial amounts. The marble is chiefly in rough blocks, not only because of the higher import duty on dressed or manufactured material but also because thin, brittle slabs must be packed carefully to avoid breakage in transit.

Imports of building and monumental marble, after declining from 1910 to 1918 began to rise and in 1927 exceeded the 1923-25 average by 44 percent. After 1931, however, they declined more rapidly than domestic production, amounting in 1934 to but 3 percent of the 1923-25 average, and then failed to keep pace with recovery either of domestic production or of building construction.

Much of the marble has been imported to satisfy personal preference of architects or because of the prestige of certain well-known types that have been used in many of the famous buildings of Europe. For exterior use, domestic marbles wear better than imported marbles, and most imports today are for interior use and more especially for highly colored and variegated effects, which are not obtainable with domestic marbles. The demand for marble for use as interior trim, floors, and decoration is declining owing to modernistic trends in design and to competition from chromium, stainless steel, glass, ceramics, plastics, and other new materials. The value of imports of manufactured-marble monuments, benches, vases, and other articles declined from over $500,000 in 1929 to less than $70,000 in 1937. Although lower labor costs in foreign countries and relatively low water-transportation rates favor continued importation of manufactured forms, it is doubtful whether imports of such manufactures will again reach the 1929 figure, partly because of displacement by plastics and other competing materials.

Although imports of slabs or paving tile and mosaic cubes dropped off markedly from 1929 to 1937, this decline was less than that for rough blocks and sawed or dressed materials and was more in conformity with the general decline in building construction. Small quantities of such materials are imported from Cuba, but most of it originated in Belgium and Italy, chiefly the latter. Here, again, requirements formerly satisfied by imports may be met by using ceramic tiles and other floor and wall-covering materials as well as by domestic natural stone.

Granite

Granite is one of the most common rocks found in nature and occurs in a multitude of colors and textures. The more popular types enter international trade in both rough and finished forms. Rigid requirements for structural qualities, uniformity in grain size, and economic factors eliminate stone from all but a relatively few localities. Granite is one of the hardest natural stones used for structural purposes, is durable, and takes a high polish that brings out the crystal structure of the component minerals, which are essentially feldspar, quartz, and mica or hornblende.

Dimension granite is used principally in monuments and buildings and for paving blocks, curbing, and rubble. Production in the United States is carried on in the Appalachian belt from Maine to Georgia, in the Midwestern States Minnesota and Wisconsin, in the Rocky Mountain States, and on the Pacific coast. In 1927, just before the building boom reached its height, approximately 1,800,000 tons of dimension granite valued at more than $25,000,000 was sold or used by producers in the United States. In 1937 the tonnage was slightly more than 750,000, valued at a little under $11,500,000.

Imports of granite are small compared with domestic production and come chiefly from Finland and Sweden. The latter furnished the so-called black granite and the former the well-known Finnish reds, which when polished produce characteristic effects for building and monumental purposes. The value of imports of rough and dressed granite decreased from about $672,000 in 1929 to less than $246,000 in 1937. Exports of granite, and in fact those of all building and monumental stone other than marble, are insignificant.

Sandstone, Limestone, Freestone, Lava and other Miscellaneous Stones

These materials, which are considered under a single classification (Stone, other) in import statistics, may be defined as follows: Sandstone is of sedimentary origin, consisting of quartz grains bound together by a cementing material; freestone is the name given to a type of sandstone that can be worked easily; limestone is of sedimentary origin and is formed by the deposition of particles of calcium carbonate and subsequent consolidation by the presence of overlying sediments; and lava includes various types of volcanic rock that cooled quickly.

Sandstone and limestone are used extensively as building materials. Lava is used mainly crushed for ballast or road metal, seldom as a building stone.

Limestone is the most widely used building stone for both construction and architectural purposes and is followed, in order, by granite, sandstone, and marble. Limestone deposits are widely distributed in all countries and occur in every State in this Nation. Deposits containing stone suitable for building purposes are not so prevalent, and although limestone is quarried in more than 25 States, Indiana produces over 75 percent of total output, Alabama, Texas, Wisconsin, Minnesota, and Illinois accounting for most of the remaining 25 percent.

Sixty percent of the sandstone produced is used for building purposes. Most of the remaining 40 percent is manufactured into curbing and flagging stones. Ohio leads in production, supplying more than 50 percent, and Maryland, Pennsylvania, Virginia, and Washington contribute substantial quantities. Imports of sandstone, limestone, freestone, lava, and other stone not elsewhere specified represent only a fraction of 1 percent of the domestic output of these materials.

Travertine

Although figures for domestic production of travertine are included with those for limestone, import statistics treated the unmanufactured stone under a separate classification and rate of duty in 1937. Like limestone and marble, travertine is essentially calcium carbonate. The stone is used principally for interior wall decorative effects, floor tile, and steps. Imports in recent years have come chiefly from Italy. In 1937 13,404 cubic feet of unmanufactured travertine valued at $18,677 was imported.

Domestic deposits of travertine considered comparable to the Italian stone are found in California and Colorado. Other deposits of travertine are in Florida, Georgia, and Montana. None of the domestic deposits has been developed extensively, because freight rates to the eastern markets and lower wages favor imports from Italy.

Slate

Another building material of high enough value to enter international trade is slate, a rock formed by the metamorphism of beds or deposits of clay and shales. Slate has an excellent cleavage that permits splitting into flat, thin sheets for use as roofing, blackboards, and school slates. Other important slate products are electric panels and structural materials, such as steps and baseboards. Small quantities of the waste produced is ground for use as a filler.

Slate is quarried in the United States principally in Pennsylvania, New York, Vermont, Maine, and Virginia. The United Kingdom ranks first in production, with the United States second. Virtually all countries have enough to satisfy their own needs, and until recent years most of the slate shipped to the United States came from Italy in the form of manufactured products, which were imported because of their cheapness as compared to domestic products. In 1937 imports of slate manufactures were valued at $4,824, of which almost 50 percent came from the United Kingdom. The slates available

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in this country are comparable to those produced in England and Wales, and imports could cease without hardship.

OTHER BUILDING MATERIALS

Sand and Gravel

Imports of sand and gravel (excluding glass sand), which were valued at more than $750,000 in 1929, declined in value to about $171,000 in 1937. A large proportion of the imports came from Canada through the Buffalo and Michigan customs districts, where they enter duty free in competition with sand and gravel produced locally. With the low average price per ton received for these commodities, imports resulted more from proximity to certain consuming centers than to any deficiency in domestic supplies.

Quartzite and Traprock

Quartzite is used only in small quantities as a building material, its principal use being for lining tube mills and for sundry chemical and metallurgical purposes. Customs statistics for 1929 do not separate imports of quartzite from those of traprock, which is mainly consumed in road construction. Owing to the proximity of Canadian quarries to consuming centers across the border and to cheap water transportation, virtually all imports of these materials come from Canada, but they amount to less than 1 percent of the domestic output.

Cement

Cement is one of the most important construction materials in almost any phase of national defense and perhaps the most important in highway construction. The principal raw materials are limestone, clay or shale, and blast-furnace slag, all of which, with fuel supplies, are abundantly available in this country.

Lower wages and cheap water transportation have enabled foreign producers to ship considerable quantities of cement into the large consuming areas along the Atlantic, Gulf, and Pacific coasts. The United States is the world's largest cement producer, but its international trade in cement has been relatively small. In 1937, imports for consumption, which originate chiefly in Belgium, Denmark, Germany, and the Netherlands, amounted to more than 1,800,000 barrels compared with American cement exports of about 379,000 barrels. The fact that these sources are no longer available presents no problem in procurement, because during the same year (1937) domestic plants produced more than 118,000,000 barrels of cement while operating at less than 50 percent of estimated capacity. Full-capacity production of domestic plants should be sufficient to supply both immediate defense needs and expanded industrial requirements. United States, Canadian, and Latin American production capacity is able to supply any cement deficiencies in the Western Hemisphere resulting from the blockade of continental Europe.

Lime

The greatest demands in history may be placed on the industry to produce agricultural, building, and chemical lime and lime for glassworks, paper mills, water-purification plants, tanneries, metallurgical plants, and other chemical industries. However, the extensive high-grade limestone deposits and ample plant capacities are estimated to be capable of satisfying the demand.

Limestone deposits are found in every State and have been worked upon a commercial basis in the production of lime in more than 40 States. Supplies of fuel to convert the stone into lime by driving off its carbon dioxide content are likewise adequate.

Lime imports, which are mainly from Canada and enter the United States at Pacific customs ports, are relatively insignificant compared with domestic production and are more than offset by exports. In 1937, when domestic production totaled 4,124,165 tons, or about 14 percent less than the all-time peak production of 1925, imports were approximately 8,500 short tons. That plant capacity is more than ample for any anticipated needs is indicated by the fact that during 1935, when almost 3 million tons was produced, plant capacity was estimated at almost 9 million tons.

Gypsum

Like the United States, the other industrial countries of the world have large deposits of gypsum, and most of them supply their own needs. The material is used as a portland-cement retarder, land plaster and building plaster and for making wallboard and lath. It is also used in the glass and ceramic industries. Imports result more from ability of foreign producers to deliver at low cost rather than from deficiencies in domestic resources. This is especially true of our large imports of Canadian gypsum, which, as crude, enter duty free to compete successfully along the Atlantic seaboard with domestic production, which is centered chiefly in New York, Michigan, Iowa, and Texas. In 1937 imports of 897,484 short tons of crude gypsum contributed almost 23 percent of the apparent new supply. There are vast deposits in Iowa, Kansas, and Oklahoma and in other States west of the Mississippi, but these producing areas cannot match producing costs plus rail freight with production costs plus cheap water transportation from the Maritime provinces.

Asbestos

Asbestos is used in the building industry in several forms, the most important of which are asbestos-cement products such as roofing shingles, wall board, mill board, and corrugated siding; paper for weather- and soundproofing; and various forms of furnace-pipe and boiler coverings. The United States leads the world in production of asbestos products and normally exports large quantities but produces less than 6 percent of its requirements of crude material. In view of this deficiency, asbestos has been listed as a critical material by the Army and Navy Munitions Board.

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Domestic production is carried on largely in Vermont and Arizona, but small quantities of both amphibole and chrysotile are produced in other States. Canadian mines in the Province of Quebec are the world's leading producers. Second in tonnage is Russia, followed by Rhodesia.

There are two types of asbestos - amphibole and chrysotile. The former is composed of silicates of calcium, sodium, iron, or magnesium. Only two minerals of the amphibole group, amosite and crocidolite, are used to any extent for spinning fiber. Anthophyllite and actinolite fibers are too brittle for spinning but are used for heat insulation, and in cements, plaster and paints. Tremolite has particular acid-resisting qualities and is widely used in filter pads. Chrysotile, a hydrous silicate of magnesium, furnishes most of the world supplies of asbestos. Its silky and strong fibers can be spun into cloth and fabric, much the same as cotton, rayon, and wool.

Other thermal insulators, such as mineral wool and vermiculite, could be substituted for asbestos for some purposes, but for the essential uses there appear to be no immediate substitutes.

Tiles

Clay tiles are flat and variously shaped articles and consist essentially of clay; they are used for finishing floors, walls, ceilings, and roofing of buildings and for sanitary and decorative purposes. Wall tiles are invariably glazed, while floor tiles are generally unglazed. Ceramic mosaics are small, irregular floor pieces of different colors. Roofing tiles and quarry tiles for floors are made of low-grade clays similar to those used in making common brick.

Imports of the various tiles declined markedly from 1929 to 1937; in 1929 they were valued at over 1 million dollars, in 1937 at less than $125,000. Lower-grade tiles, such as cement tile, were imported from Mexico and Cuba and unglazed tiles mainly from Italy and Belgium. Japan and the United Kingdom supplied the great bulk of the glazed-tile imports, the latter country furnishing about 75 percent of those valued at over 40 cents a square foot. Ceramic mosaics were imported mainly from Japan and Belgium. Cuba and the United Kingdom supplied most of a group of miscellaneous tiles.

Domestic production capacity is known to be substantial. Imports have been able to compete with American tile products only at seacoast cities, New York and Los Angeles being the ports of entry for more than 80 percent of total imports. Normally the volume and value of tile exports exceed those of imports. Countries in the Western Hemisphere have been the principal outlet for exports of American tile.

Raw materials for the manufacture of the best grades of tile are abundantly available in this country. There would be shortage if imports were cut off completely.

Structural Brick

In this classification may be included common brick, face brick, hollow brick, hollow-clay building tile, sand-lime brick, and cement or concrete brick - in fact, all kinds of brick used for structural purposes except glazed, enameled, painted, or vitrified brick, the imports of which were valued at less than $200 in 1937.

Although statistics are not available on the capacity of domestic plants to produce the various items under the structural-brick classification given above, it can be assumed safety that any necessary quantities will be available as needed, as low-grade clays and fuels, the essential raw materials, are widely distributed in this country, and firing kilns and drying sheds can be constructed as needed. Brick plants are necessarily located not far from the large consuming areas to avoid high freight costs, which represent a considerable portion of the delivered price of the product.

Imports have not seriously competed with American output because producers face the handicap of prohibitive freight charges over long distances. In recent years imports have equaled but a fraction of 1 percent of domestic output and compete only at points close to the Canadian and Mexican borders. The volume of exports from plants in the same border States exceed that of total imports.

Glass

The glass industry was in its infancy in this country as recently as 50 years ago; not only our entire requirements of optical and ophthalmic glass but also of sheet and plate glass were supplied by imports. Even before the World War of 1914-18 all kinds of glass were imported in large quantities because of the lower costs of manufacture in European countries. With the development of the drawing and casting processes of manufacture the United States has become one of the leading producers and now enjoys a considerable export business.

In 1929 imports of cylinder, crown, and sheet glass for ordinary glazing purposes amounted to about $2,770,000. Most of the imports originated in Belgium, Czechoslovakia, and Germany, sources no longer available. During 1929, however, domestic production of these glass products was valued at roughly $37,000,000. In 1937 the value of imports was little more than half of that recorded for 1929. Imports have persisted, however, because foreign production and transportation costs are somewhat lower than those at seacoast cities. A seemingly high protective tariff has not excluded imports from the leading European producers.

Any increase in demand for plate and window glass can be satisfied by domestic plants, as both raw materials and plant capacity in this country are adequate. Even the best optical grades can be produced here in sufficient quantities. The supply of lenses for bomb sights, telescopes, binoculars, and range finders is limited only in fabrication, where a supply of skilled labor may be lacking.